

**MULTIPLE FLUID COLLECTIONS IN THE CHEST IN THE
COURSE OF THERAPEUTIC PNEUMOTHORAX.¹**

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It is the purpose of this paper to call attention to multiple fluid collections in the chest that occur in the course of induced pneumothorax. This condition cannot be detected by physical examination, and it is recognized only by the characteristic multiple fluid-levels shown on roentgenologic examination. There is usually seen one or more secondary fluid-levels superimposed upon and parallel to the level of the main effusion, and under the fluoroscope a fluid wave can be elicited on each level independently. Among 32 cases of hydropneumothorax we encountered this condition in 5 instances.

It is obvious that the essential factor entering into the causation of such multiple fluid collection is extensive pleuritic adhesions, but the exact mechanism of their production requires further explanation. It would be reasonable to assume that this condition is due to adhesions so distributed as to divide the potential pleural cavity into two or more non-communicating compartments, so that when attempts to induce pneumothorax are made at different points of the chest, two or more pneumothorax pockets may be produced, and when an effusion subsequently supervenes the fluid accumulates in each compartment separately, or pneumothorax is induced in one compartment and a spontaneous pneumothorax occurs in a compartment adjacent thereto.

But while the just described mechanism explains the causation of multiple localized hydropneumothoraces in one of our cases it does not do so in the others that came under our observation, inasmuch as we succeeded in inducing a fair pneumothorax in these cases at the first attempt, and all subsequent punctures were made in areas where the fluoroscope showed a definite pneumothorax, thereby excluding the possibility of the existence of independent pockets.

In view of frequent roentgenologic examinations, before and after the development of the effusions, we are led to believe that in most cases this condition is due to sheet-like adhesions spreading in hammock-like fashion from the visceral pleura across the pneumothorax area to the chest wall. These adhesions, when an effusion supervenes, serve as a receptacle to catch the fluid secreted from the pleural surface above their insertion, and at the same time part

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of the main effusion below may also be entrapped therein by change of the patient's posture.

It is pertinent to interpolate that certain multiple fluid collections are due to fluid-containing cavities coexisting with hydropneumothorax.

REPORT OF CASES.

MULTIPLE FLUID COLLECTIONS DUE TO A SPONTANEOUS PNEUMOTHORAX SUPERIMPOSED UPON A LIMITED INDUCED PNEUMOTHORAX.

CASE I.—A. C., aged twenty years, admitted August 12, 1918, with a typical history of active pulmonary tuberculosis and recurrent attacks of pleurisy on the right side. Examination showed extensive, active tuberculosis on the right side. Right pneumo-



FIG. 1.—Case A. C. Note two fluid levels on right side.

thorax was induced on December 2, 1918. Fluoroscopic examination after the first few inflations showed a fair collapse of the right upper lobe; the lower lobe was held down by adhesions. On January 19, 1919, the patient developed chills and fever and hydropneumothorax was detected two days later.

Physical examination subsequently showed the fluid to be up to the third rib, breath sounds and whispered voice being practically inaudible below that level.

On January 22 the patient was seized with a severe stabbing pain in the right lower midaxillary region, and when she was first seen

she was dyspneic and quite cyanosed. Physical exploration of the chest revealed amphoric whisper and distant amphoric breathing below the described level. The possibility of a spontaneous pneumothorax was suggested, inasmuch as previous fluoroscopic examinations showed that the lower lobe was not at all collapsed. On January 28 fluoroscopic examination disclosed two definite fluid levels, each giving an independent splash. The two pockets seemed to be non-communicating. A roentgenogram (Fig. 1) taken the same day confirmed the fluoroscopic findings.

It is evident that in this case the two fluid levels were caused by two independent pockets of hydropneumothorax, one artificial and one spontaneous.

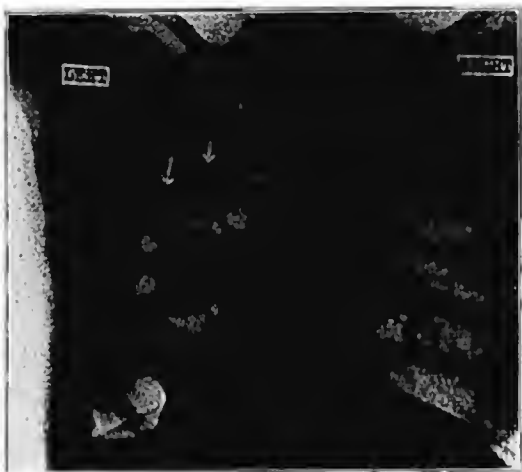


FIG. 2.—Case M. L. Note adhesions on level of second and third ribs.

MULTIPLE FLUID COLLECTIONS CAUSED BY HAMMOCK-LIKE ADHESIONS.

CASE II.—M. L., aged twenty-five years, housewife, admitted March 10, 1919, with extensive and active left-sided tuberculosis. Left pneumothorax was induced July 30, 1919. A roentgenogram taken October 21, 1919 (Fig. 2), shows a fairly complete collapse of the left lung except that there are bands of adhesions stretched across the pneumothorax area to the chest wall on the level of the second and third ribs. During November, 1919, the patient developed an effusion, and a roentgenogram (Fig. 3) taken December 19,

1919, shows a hydropneumothorax with two definite fluid levels, one on the level of the second rib and one on the level of the fifth rib.

It is evident that in this case the upper compartment of fluid collected on top of adhesions that have been present prior to the induction of pneumothorax, inasmuch as the upper fluid level corresponds exactly to the level of the adhesions that were definitely seen before the effusion developed.



FIG. 3.—Case M. L. Note fluid levels on left. The upper level corresponding to location of adhesions as seen in Fig. 2.

HAMMOCK-LIKE ADHESIONS AS A RESULT OF PREEXISTING THICKENED INTERLOBAR SEPTUM PRODUCING MULTIPLE FLUID LEVELS.

Sheet-like adhesions are sometimes the result of pathologic changes in the interlobar septum. When pneumothorax is induced in these cases the parietal and visceral pleurae remain adherent at a point corresponding to the interlobar septum, and the lung may be collapsed above and below that level, thus leaving a shelf-like sheet of fibrous structure on which fluid may accumulate. The following case illustrates this condition:

CASE III.—M. P., aged twenty-two years, admitted July 19, 1919, with a typical history of pulmonary tuberculosis. Examination showed tuberculous involvement of the right upper and middle lobes and left apex. A roentgenogram (Fig. 4) showed diffuse infiltration throughout the upper two-thirds of the right lung, with

multiple small cavities in the infraclavicular region. At the level of the third rib anteriorly there was a small, very dense, triangular



FIG. 4.—Case M. P. - Note density in region of interlobar septum on right.

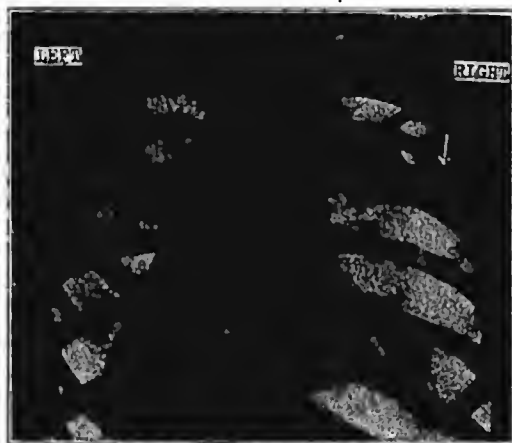


FIG. 5.—Case M. P. Note adhesions in location corresponding to location of thickened interlobar septum seen in Fig. 4.

area, the base of the triangle being toward the periphery. This was undoubtedly a thickened interlobar septum.

A right pneumothorax was induced on August 8, 1919, and a roentgenogram (Fig. 5) taken six weeks later showed an irregular area of pneumothorax occupying the major part of the right pleural cavity, and there was a heavy band of adhesions running horizontally from the lung to the chest wall on the level of the third rib. This point corresponded exactly to the location of the thickened interlobar septum seen on a previous plate. During November, 1919, the patient developed an effusion, and a roentgenogram (Fig. 6) taken November 25, 1919, showed three fluid levels, the



FIG. 6.—Case M. P. Plate taken in oblique position. Note three fluid levels. The uppermost probably due to a fluid-containing cavity. Middle level in location of thickened interlobar septum seen in Figs. 4 and 5.

main fluid level at about the fourth rib, a secondary fluid level at the third rib and a small fluid collection at the third space near the root, each fluid level giving an independent fluid wave on fluoroscopy.

In this case it is obvious that the hammoek-like adhesion on which the secondary fluid collection accumulated is due to pre-existing pathologic changes in the interlobar septum, as a comparison of Figs. 4, 5 and 6 will readily show. The small fluid collection at the third space near the root is most probably due to a cavity partly filled with fluid.

MULTIPLE FLUID LEVELS CAUSED BY SHELF-LIKE ADHESIONS FORMED
BY THE ORGANIZATION OF THE EXUDATE PRESENT.

In the above-described cases the adhesions that caused the secondary pockets of fluid were present prior to the induction of the pneumothorax, but we also observed cases in which there were no preëxisting adhesions in the pneumothorax area; but as a result of the organization of part of the exudate, shelf-like septa were formed. These newly formed fibrous structures supported part of the fluid, and on roentgenologic examination multiple fluid levels were seen. The following cases illustrate this condition:



FIG. 7.—Case G. F. Note small adhesions at level of second space and absence of adhesions below.

CASE IV.—G. F., female, aged twenty-six years, housewife, was admitted May 5, 1919, with extensive, active tuberculosis involving the entire right lung and the left apex. Right pneumothorax was induced June 19, 1919, and a roentgenogram (Fig. 7) taken June 24, 1919, shows a fairly complete collapse of the entire right lung. The collapse was specially marked at the base, the lung being collapsed upward and inward. There was, however, a band of adhesions at the level of the second space running from the lung to the chest wall.

During the month of September, 1919, the patient developed an effusion, and a roentgenogram (Fig. 8) taken September 24, 1919, showed three levels of fluid at the levels of the second, fifth and

sixth ribs respectively. Fluorosecopy showed independent fluid waves on each fluid level.

In this case, besides the fluid collection in the region of the pre-existing adhesions at the second space, there is another secondary fluid level at the fifth rib, where, as seen from the previous plate, there were no adhesions. It is certain, therefore, that the adhesions causing this secondary fluid-level were newly formed as a result of the organization of the exudate.

CASE V.—R. P., male, aged forty-eight years, tailor, was admitted January 14, 1918, with extensive tuberculosis involving the entire left lung. Left pneumothorax was induced May 13, 1918.



FIG. 8.—Case G. F. Note three fluid levels. The uppermost in region of previous adhesions. The middle in an area previously free from adhesions.

Fluorosecopy, after the first few inflations, showed a localized pneumothorax occupying the axillary portion of the lower half of the pleural cavity.

During December, 1918, the patient developed an effusion and a roentgenogram taken January 7, 1919 (Fig. 9), showed three fluid-levels within the area previously occupied by free pneumothorax, the relation of the three fluid-levels to each other being somewhat step-like in character. Under the fluoroscope three independent fluid waves were seen.

Here, again, the triple fluid-levels developed in an area previously

free from adhesions, so that the organization of the exudate was undoubtedly the cause of the secondary collections of fluid.

Summary. 1. Careful observation of 32 cases of hydro-pneumothorax disclosed the presence of multiple fluid collections in 5 cases.

2. This condition could not be detected without the aid of the roentgen ray, which showed characteristic multiple fluid-levels.

3. Two or more independent hydro-pneumothorax pockets may be produced as a result of attempts to induce pneumothorax at different levels of the chest or a localized spontaneous pneumothorax may occur adjacent to a pocket of artificial hydro-pneumothorax.



FIG. 9.—Case R. P. Note three fluid levels on left side.

4. The most important factor in the causation of this condition is pleuritic adhesions which spread out in hammock-like fashion from the visceral pleura across the pneumothorax area to the chest wall. These adhesions may be present before the induction of the pneumothorax and may occasionally be the result of a thickened interlobar septum, or they may be newly formed as a result of organization of the exudate.

5. The coexistence of a fluid-containing cavity with a hydro-pneumothorax may also give rise to multiple fluid levels.